

UMBRELLA UNFOLDABLE AND FOLDABLE FIXED CANOPY STRUCTURECROSS REFERENCE TO RELATED APPLICATIONS

This application is the US national phase of PCT application PCT/EP2004/003065, filed 23 March 2004, published 14 October 2004 as WO 2004/086898, and claiming the priority of German patent application 20305166.1 itself filed 31 March 2003 and German patent application 20305168.8 itself filed 31 March 2003, whose entire disclosures are herewith incorporated by reference.

FIELD OF THE INVENTION

10 The invention relates to an openable and closable umbrella that is used for protection against the weather, e.g. sun and/or rain, and where any rain water falling on it is deflected outward by a canopy (FIG. 1a).

BACKGROUND OF THE INVENTION

15 Umbrellas are known whose canopies are pointed, with the points directed up or down, and wherein the canopies, as so-called funnel umbrellas, are of two-parts and oppositely curved.

20 Umbrellas are predominantly used to deflect rain water outward. The arms supporting the canopy of such an umbrella are never completely above the canopy, but are wholly or partly underneath the canopy. The arms of these umbrellas are normally held on a shaft and supported by diagonal spreaders. They are often bent when in use.

25 Less well known are umbrellas that direct rain water inward toward the shaft. Such embodiments have arms above and/or below.

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The particular disadvantage here is that the umbrella as a result of its basic shape is quite large because the pivots of the arms lie at different levels and the umbrella cannot be compactly folded together to be short. In addition the elements underneath the canopy have a support function so that the canopy when erected stands well above them and protection from the weather is reduced. The mechanism with guide wheels and cables in the shaft running to a winch is prone to failure and complex. In addition the canopy has a central opening that can be a problem when it rains.

#### OBJECT OF THE INVENTION

It is an object of the invention to provide an openable and closable umbrella that directs rain water outward, where the canopy is fully exposed on its underside.

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#### SUMMARY OF THE INVENTION

This object is attained with the features of claim 1, in that the arms supporting the canopy are wholly above the canopy and do not project through it (FIG. 1).

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With the invention the canopy seen from below is used in a manner not hitherto valued and the bottom view can be used in a novel manner, e.g. to carry printed matter and artwork of every type, in particular advertising and product art.

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Umbrellas according to the invention can be of any size. It is for example possible to produce according to the dependent claims huge umbrellas with a surface area of for example more than 100 m<sup>2</sup>, cafe-style umbrellas, small umbrellas for personal use, and even rain umbrellas.

~~In the dependent claims~~

~~2 to 19 describe preferred three-dimensional shapes for the canopy,~~

~~20 to 26, describe preferred embodiments of the arms,~~

~~27 to 34 describe preferred embodiments of the opening and closing mechanism~~

~~35 to 36 describe preferred embodiments showing the grouping and interconnection of several umbrellas, and~~

~~37 describe preferred embodiments of illumination.~~

~~The embodiment of dependent claim 2 is advantageous in that According to the invention the canopy has a wavy shape in an elegant light construction and with double opposite curvature so as to have considerable stability with respect to wind so that its service life is also increased (FIG. 2).~~

~~The embodiment of dependent claim FIG. 3 is advantageous in that the canopy has a wavy shape in an elegant light construction and with double opposite curvature so as to have considerable stability with respect to wind so that its service life is increased (FIG. 3).~~

~~The embodiment of dependent claim FIG. 4 is advantageous in that the canopy has an upwardly and downwardly folded shape defined by the lines of the lower (previously presented)s and as a result of its support on the lower (previously presented)s and its double opposite curvature in sections it has a high stability with respect to wind (FIG. 4).~~

~~The embodiment of dependent claim FIG. 5 is advantageous in that the canopy has an upwardly and downwardly folded shape~~

defined by the upper (previously presented)s and subdivided into sections and has as a result of its mounting on the upper (previously presented)s and its double opposite curvature considerable stability against wind (FIG. 5).

5 The embodiment of ~~dependent claim~~ FIG. 6 is advantageous in that the canopy has an upwardly and downwardly folded shape with its folds acting dynamically like a windmill and being made of materials without particular static properties (FIG. 6).

10 The embodiment of ~~dependent claim~~ FIG. 7 is advantageous in that the canopy is conical, practically smooth and simple, and leads dropping rain water uniformly to all sides (FIG. 7).

15 The embodiment of ~~dependent claim~~ FIG. 8 is advantageous in that the canopy has a wavy shape creased at the lower (previously presented)s, and is simple and stable and can be made of material without particular static properties (FIG. 8).

20 The embodiment of ~~dependent claim~~ FIG. 9 is advantageous in that the canopy has a wavy shape as a result of the edge treatment without losing attractiveness and with its edge guides and double opposite inflections it has a particularly good stability with respect to wind (FIG. 9).

25 The embodiment of ~~dependent claim~~ FIG. 10 is advantageous in that the canopy is forced in to a wavy shape and has no points so that it is an extremely elegant shape and in fact has a sculpted look and once again has as a result of its edge treatment and double opposite inflections a particularly good stability with respect to wind (FIG. 10).

The embodiment of ~~dependent claim~~ FIG. 11 is advantageous in that the canopy looks like a windmill and the lightness of its construction is emphasized (FIG. 11).

5 The embodiment of ~~dependent claim~~ FIG. 12 is advantageous in that the appearance of the canopy can be changed by sliding the canopy center, water being shed better as the canopy center is raised and fixing of the canopy center increasing stability with respect to wind (FIG. 12).

10 The embodiment of ~~dependent claim~~ FIG. 13 is advantageous in that the canopy assumes a natural shape, can be sealed around the shaft, and fixing of the canopy center increases stability with respect to wind (FIG. 13).

15 The embodiment of ~~dependent claim~~ FIG. 14 is advantageous in that the canopy is more elegant because of its loose mount on the umbrella axis, so that it freely assumes a natural shape, and no expensive mounting hardware is needed at the center (FIG. 14).

20 The embodiment of ~~dependent claim~~ FIG. 15 is advantageous in that the canopy with no shaft going through it is very elegant and its center is available for printing advertising and in addition the center is particularly water tight and no special reinforcements are needed in the center (FIG. 15).

25 The embodiment of ~~dependent claim~~ FIG. 16 is advantageous in that the canopy is quite striking, in particular dimensionally stable and statically reinforced by the sewn-in straps or cables (FIG. 16).

The embodiment of ~~dependent claim~~ FIG. 17 is advantageous in that the canopy is both elegant and striking, dimensionally

stable, and statically reinforced by the sewn-in straps and cables (FIG. 17).

5 The embodiment of ~~dependent claim~~ FIG. 18 is advantageous in that the canopy is particularly elegant and does not need additional straps or cables (FIG. 18).

The embodiment of ~~dependent claim~~ FIG. 19 is advantageous in that because of the shaped edge the umbrella is more elegant and the canopy is additionally tensioned at its edge (FIG. 19).

10 The embodiment of ~~dependent claim~~ FIG. 20 is advantageous in that the separation of the functions of the upper and lower (previously presented)s has the interesting result that there are additional degrees of freedom and possibilities of tensioning and with high lower (previously presented)s can have strongly pulled down canopy corners (FIG. 20).

15 The embodiment of ~~dependent claim~~ FIG. 21 is advantageous in that the umbrella is lighter because the tension and pressure forces are separated, the (previously presented)s pulled upward by cables have great strength resisting gravity and wind and can be tensioned by the cables (FIG. 21).

20 The embodiment of ~~dependent claim~~ FIG. 22 is advantageous in that the forces are contained in that the ends of the diagonal spreaders bear with some elasticity on the upwardly held (previously presented)s so that the canopy is well tensioned and held by the spreaders (FIG. 22).

25 The embodiment of ~~dependent claim~~ FIG. 23 is advantageous in that the use of the static properties of the canopy has an elegant effect, the lower (previously presented)s held up by the

canopy provide some elasticity and the static properties tension the canopy at the lower (previously presented)s and reduce the number of parts (FIG. 23).

5 The embodiment of ~~dependent claim~~ FIG. 24 is advantageous in that separation of the pushing and pulling forces makes the umbrella lighter, the (previously presented)s engaged underneath by the cables can be pushed with considerable vertical strength to resist wind pressure and suction and prestress the system with the cables (FIG. 24).

10 The embodiment of ~~dependent claim~~ FIG. 25 is advantageous in that containing the force makes the umbrella more compact, provides some elasticity of the arms where they are engaged by the diagonal spreaders, provides excellent tensioning of the canopy, and prestresses with the spreaders (FIG. 25).

15 The embodiment of ~~dependent claim~~ FIG. 26 is advantageous in that the use of the static properties of the canopy has an elegant effect, bracing of the spreaders underneath the arms provides some elasticity that prestresses the static properties of the canopy, and can be made with fewer parts (FIG. 26).

20 The embodiment of ~~dependent claim~~ FIG. 27 is advantageous in that as a result of dropping the pivotal connection and thereby lowering the arms it is particularly easy to open while raising the pivotal connections requires little room for closing, so that for example there is ample room underneath for a table and no particular means need be provided to tension the canopy since all 25 of the arms are pushed upward with the diagonal spreaders by the cables (FIG. 27).

5 The embodiment of ~~dependent claim~~ FIG. 28 is advantageous in that the use of the lower arms without cables or diagonals is more elegant, so that a lowering of the pivotal connection and the thus reduced vertical movement of the arms makes opening the umbrella easier and as a result of raising the pivotal connection less room is needed for closing it so that for example there is ample room underneath for a table and the existing tension uses the canopy so that no cables or diagonal spreaders for the lower arms are needed (FIG. 28).

10 The embodiment of ~~dependent claim~~ FIG. 29 is advantageous in that use of the push-type diagonal spreaders makes the mechanism short, since above the connection of the arms no shaft is necessary and no particular tensioning devices need be provided for the canopy, since all the arms are raised by the cables or diagonal spreaders (FIG. 29).

15 The embodiment of ~~dependent claim~~ FIG. 30 is advantageous in that with no diagonal spreaders or cables engaging the lower arm the umbrella is more elegant, and use of diagonal pushers makes the structure short since above the connection of the arms no shaft need be provided and the existing tension uses the canopy so that no cables or diagonal spreaders are needed for the lower arms (FIG. 30).

20 The embodiment of ~~dependent claim~~ FIG. 31 is advantageous in that no expensive mechanism for moving the umbrella tip or runner sleeve is needed for the umbrella since use of the pushing diagonal spreaders makes the structure short and the shaft need not extend above the connection and no particular tensioning means are

needed for the canopy since all the arms are raised by the cables or diagonal spreaders (FIG. 31).

5 The embodiment of ~~dependent claim~~ FIG. 32 is advantageous in that, as a result of there being no cables or diagonals for the lower arms, the umbrella is more elegant, no expensive mechanism is needed to move the umbrella tip or sleeve, the diagonal spreaders fit in a small space, and no shaft is needed above the joint so that no cables or diagonal spreaders are needed for the lower arms (FIG. 32).

10 The embodiment of ~~dependent claim~~ FIG. 33 is advantageous in that the umbrella with upper arms [[(31)]] and lower arms [[(32)]] can be folded completely together (FIG. 33).

15 The embodiment of ~~dependent claim~~ FIG. 34 is advantageous in that when folded up the umbrella has no big folds and thus rain water runs better out (FIG. 34).

20 The embodiment of ~~dependent claim~~ FIG. 35 is advantageous in that the umbrellas fit elegantly together in a row, dropping rain water is largely moved to the outside, they can be put together into other groupings or used alone, when linked up they can be mechanically interconnected for greater wind resistance, and a larger integrated rain-protected surface is created since with a hanging system the area underneath the canopies is free of masts (FIG. 35).

25 The embodiment of ~~dependent claim~~ FIG. 36 is advantageous in that the umbrellas form an elegant system when grouped together, dropping rain water is largely directed outward, the umbrellas can be set out individually or used in other formations and when

grouped together can be mechanically interconnected to form a larger more wind-resistant rain-protected space which when hung is even free of masts (FIG. 36).

5 The embodiment of ~~dependent claim~~ FIG. 37 is advantageous in that the umbrella can be futuristically illuminated, effectively used as a light sculpture or lamp, and printing on the canopy with advertising can be displayed dramatically (FIG. 37).

10 All the arms of the umbrella normally extend radially of the umbrella axis. This is advantageous in that the forces effective on the arms are transmitted directly to the umbrella axis and the arms pivoted on the axis can easily be folded together.

15 In the open position all or some of the arms extend downward, their outer ends and the corresponding corners of the canopy of each arm lying below their inner ends at the canopy center. This is advantageous in that it deflects falling rain water outward.

20 In particular in embodiments with conical canopies the longitudinal axes of the arms intersect the umbrella axis at a common point. Their outer end are in this variant are coplanar. Preferably in this embodiment the structure is very compact and symmetrically resists applied forces.

25 The arms of the umbrella can be straight or bent. According to embodiment, the arms are either compressed or bent. The arms can be particularly resistant to bending or quite elastic. By varying the properties of the arms it is possible to make the static system accord optimally with the desire appearance of the umbrella embodiment.

The umbrellas can have any desired geometric shape (FIG. 38), in particular shapes are possible where the canopy corners are distributed seen in top view uniformly around a circle or ellipse so that canopy sections are each defined between two canopy corners and the canopy axis and are of the same area. This "circular" umbrella is preferably in that the umbrella has no particular orientation and as a result of being rotation-symmetrical it is most efficiently dimensioned. The "elliptical" umbrella is advantageous in that the umbrella has an oriented shape and as a result of this elongation is particularly dynamic and elegant. Further shapes where  $4 + 4n$  canopy corners define a quadrilateral or rhombus and  $4 + 2n$  canopy corners define a rectangle. These shapes are preferable in that several umbrellas of similar shape can easily be assembled together and form a stronger larger structure. The particular shapes also include "circular" umbrellas with off-center canopy axes or "semicircular" umbrellas. A noncentered canopy axis is advantageous in a permanently mounted umbrella that can be oriented best for sun protection. The "semicircular" umbrella is advantageous as it can be set against a wall.

The umbrellas are preferably opened and closed by a winch shaft that is rotated by a crank via bevel gears. In a simplified system it is possible to open and close the umbrellas with the use of cords. The opening and closing can be mechanical, hydraulic, or assisted by an electric motor or pneumatic lifter. The mechanical system is preferably as the umbrella can be opened and closed by

pushing a button and in combination with a wind monitor it can close automatically and thus be smaller.

The opening mechanism can also be assisted by an end mount. This end mount ensures that when closed there is a minimal angle between the arms and the cables or spreaders in order to be able to exert some force on the arms to start the opening movement. According to the opening mechanism the spreaders or arms or the cables that open the arms are connected to this end mount (FIG. 40).

The tensioned canopy can also be precisely prestressed by tensioning elements. Such tensioning elements, that are fitted between the canopy points and the ends of the arms, permit the canopy to be connected to the ends of the arms when they are swung up into the open position.

The shaft that forms part of the mast and on which all of the parts directly or indirectly necessary for tensioning the canopy is mounted on an anchor or a hanger. The anchor is preferably formed as a mast and set in a movable stand or a stationary anchor hole. The hanger extends above the canopy and holds the umbrella from above. This is known from hanging umbrellas can be anchored by movable stands on the floor or in a fixed anchor on the floor or wall. It is preferable to provide a link between the rod and the anchor, so that the rod and the canopy can be tipped according to the position of the sun.

#### DESCRIPTION OF THE FIGURES

Embodiments of the invention are described with reference to FIGS. 1 to 82. To start with there is the "state of the art"

~~figure that is discussed on page 1 of this description.~~

~~Furthermore therein the drawing in which:~~

FIG. 1a illustrates the state of the art;

5 FIG. 1 shows the main claim of the patent: FIG. 1 is an isometric view of an umbrella with arms (30) wholly above the canopy (10); ~~FIGS. 2 to 29 show advantageous embodiments of the canopy with different shapes.~~

FIG. 3 is a wavy embodiment of the umbrella shown

10 (a) isometrically at an angle from in front and  
(b) isometrically at an angle from above;

FIG. 4 is a differently folded and shaped embodiment of the umbrella

(a) isometrically at an angle from in front and  
(b) isometrically an angle from above;

15 FIG. 5 is a differently folded and shaped embodiment of the umbrella

(a) isometrically at an angle from in front and  
(b) isometrically an angle from above;

20 FIG. 6 is a differently folded and shaped embodiment of the umbrella

(a) isometrically at an angle from in front and  
(b) isometrically an angle from above;

FIG. 7 is a conical embodiment of the invention

(a) isometrically at an angle from in front and  
(b) isometrically at an angle from above;

25 FIG. 8 is a conical embodiment folded along the lower arms of the umbrella

- (a) isometrically at an angle from in front and
- (b) isometrically from above;

FIG. 9 is a wavy embodiment of the umbrella

- (a) with straight canopy edge segments at an angle isometrically from in front,
- (b) with straight canopy edge segments isometrically at an angle from above,
- (c) with a curved canopy edge isometrically at an angle from in front, and
- (d) with a curved canopy edge isometrically at an angle from above;

FIG. 10 is a wavy embodiment of the umbrella without canopy corners,

- (a) with a canopy-edge bow isometrically at an angle from in front, and
- (b) with a canopy-edge bow isometrically at an angle from above;

FIG. 11 is an embodiment of the umbrella showing the canopy

- (a) isometrically at an angle from in front,
- (b) isometrically from above,
- (c) isometrically at an angle from in front and
- (d) isometrically from above;

FIG. 12 is an embodiment of the umbrella where the canopy shape is determined by how it is secured at the umbrella axis;

FIG. 13 is an embodiment of the invention where the canopy is secured at the umbrella axis but not so as to influence its shape;

5 FIG. 14 is an embodiment of the invention where the canopy is not secured at the axis but spacedly surround it;

FIG. 15 is an embodiment of the umbrella where the canopy is not necessarily cut out at the axis;

10 FIG. 16 is an embodiment of the umbrella where the canopy is folded in straight lines along sewn-in cables or straps

- (a) isometrically at an angle from in front and
- (b) isometrically from above;

15 FIG. 17 is an embodiment of the umbrella where the canopy is folded in arcs along sewn-in cables or straps

- (a) isometrically at an angle from in front and
- (b) isometrically from above;

20 FIG. 18 is an embodiment of the umbrella where the canopy has a free-form shape

- (a) isometrically at an angle from in front and
- (b) isometrically from above;

25 FIG. 19 is an embodiment of the umbrella showing the shaped canopy edge; FIGS. 20 to 26 show preferred embodiments of the arms

FIG. 20 is an embodiment of the umbrella in isometric view with upper and lower arms attached at different levels at the umbrella axis;

FIG. 21 is an embodiment of the umbrella where most or all of the arms are held up by cables,

- (a) isometrically with a wavy umbrella
- (b) isometrically with a creased conical umbrella;

FIG. 22 is an embodiment of the umbrella where most or all of the arms are held up by spreaders

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- (a) isometrically with a wavy umbrella
- (b) isometrically with a creased conical umbrella;

FIG. 23 is an embodiment of the umbrella in isometric view where most or all of the lower arms are held up by the canopy;

10 FIG. 24 is an embodiment of the umbrella in isometric view where most or all of the arms are pulled down by cables;

FIG. 25 is an embodiment of the umbrella in isometric view where most or all of the arms are held down by spreaders;

15 FIG. 26 is an embodiment of the umbrella in isometric view where most or all of the arms are pulled down by the canopy;  
FIGS. 27 to 34 show preferred embodiments of the opening and closing mechanism;

FIG. 27 is an embodiment of the umbrella opened by moving the arms downward along the axis in isometric view in different positions, namely

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- (a), (b), and (c) with all the arms held up by cables,
- (d), (e), and (f) with all the arms held up by diagonal spreaders,
- (g), (h), and (i) with all the arms held up by diagonal spreaders;

FIG. 28 is an embodiment of the umbrella opened by moving the arms downward along the axis in isometric view in different positions, namely

(a), (b), and (c) with all the upper arms held up by cables,

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(d), (e), and (f) with all the upper arms held up by diagonal spreaders,

(g), (h), and (i) with all the lower arms held up by diagonal spreaders;

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FIG. 29 is an embodiment of the umbrella opened by moving the cables or diagonal spreaders upward along the axis in isometric view in different positions, namely

(a), (b), and (c) with all the arms held up by diagonal spreaders,

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(d), (e), and (f) with all the arms held up by cables,

(g), (h), and (i) with all the arms held up by diagonal spreaders;

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FIG. 30 is an embodiment of the umbrella opened by moving cables or diagonal spreaders upward along the axis in isometric view in different positions, namely

(a), (b), and (c) with all the upper arms held up by cables and all the lower arms held up by tension in the canopy;

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FIG. 31 is an embodiment of the umbrella opened by shortening all the cables in isometric view in different positions, namely

(a), (b), and (c) with all the arms held up by cables;

FIG. 32 is an embodiment of the umbrella opened by shortening all the cables in isometric view in different positions, 5 namely

(a), (b), and (c) with all the upper arms held up by cables;

FIG. 33 is an embodiment of the umbrella showing the 10 length of the diagonal spreaders and where they engage the upper and lower arms

(a) isometrically  
(b) in section;

FIG. 34 is an embodiment of the umbrella in section with all the arms secured at the canopy axis to a runner sleeve; FIGS. 15 35 to 36 show preferred groupings of multiple umbrellas

FIG. 35 is an embodiment of the umbrella in isometric view where several umbrellas are loosely joined together in a row;

FIG. 36 is an embodiment of the umbrella in isometric view where four umbrellas are loosely joined together in a 20 quadrilateral array;

FIG. 37 shows a preferred embodiment of illumination  
~~FIG. 37 is an embodiment of the umbrella in isometric view~~  
illuminated from below; FIGS. 38 to 43 show particular embodiments

FIG. 38 is an embodiment of the umbrella in side view

25 (a) with a circular shape,  
(b) with an elliptical shape,  
(c) with a quadrilateral shape,

- (d) with a rhombic shape,
- (e) with a rectangular shape,
- (f) with an eccentric umbrella axis,
- (g) with a semicircular shape;

5 FIG. 39 is an embodiment of the umbrella in isometric view

- (a) and (b) with bent arms;

FIG. 40 is a selected embodiment of a wavy umbrella in isometric overall view carried on a mast and whose upper arms are held by cables;

10 FIG. 41 is a selected embodiment of a wavy folded umbrella in isometric overall view carried on a mast and whose upper arms are held by cables with the opening positions shown;

15 FIG. 42 is an embodiment of the rod of the umbrella in section; and

FIG. 43 is an embodiment of an arm of the umbrella in section. [[;]]

#### SPECIFIC DESCRIPTION

FIG. 1 shows in isometric view the basic idea of the invention. A number of shaped canopies [[()]] 10 [[()]] are held by arms [[()]] 30 [[()]] wholly above the canopy, here there are upper arms [[()]] 31 [[()]] and lower arms [[()]] 32 [[()]].

20 FIG. 3 shows in two isometric views a wavy embodiment of the umbrella or its canopy [[()]] 10 [[()]]. It is clear that the canopy [[()]] 10 [[()]] is tensioned at high points [[()]] 34 [[()]] and low points [[()]] 35 [[()]].

5 FIG. 4 shows in two isometric views alternately upwardly forced and downwardly folded embodiments of the umbrella or its canopy [[() 10 []]] . It is clear that the canopy [[() 10 []]] is alternately drawn up to high points [[() 34 []]] and down by lower arms [[() 32 []]] to low points. The canopy [[() 10 []]] is creased along the lower arms [[() 32 []]] .

10 FIG. 5 shows in two isometric views alternately upwardly and downwardly folded embodiments of the umbrella or its canopy [[() 10 []]] . It is clear that the canopy [[() 10 []]] is drawn down into low points [[() 34 []]] and upward by upper arms [[() 31 []]] . The canopy [[() 10 []]] forms folds along the upper arms [[() 31 []]] .

15 FIG. 6 shows in two isometric views alternately upwardly and downwardly folded embodiments of the umbrella or its canopy [[() 10 []]] . It is clear that the canopy [[() 10 []]] is alternately pushed up by upper arms [[() 31 []]] and downward by lower arms [[() 32 []]] . The canopy [[() 10 []]] forms creases along the upper arms [[() 31 []]] and the lower arms [[() 32 []]] .

20 FIG. 7 shows in two isometric views a conical embodiment of the umbrella or its canopy [[() 10 []]] . It is clear that the canopy [[() 10 []]] is drawn upward at the canopy center [[() 13 []]] along the umbrella axis [[() 10 []]] and downward by low points [[() 35 []]] .

25 FIG. 8 shows in two isometric views a conical embodiment of the umbrella or its canopy [[() 10 []]] creased along the lower arms. It is clear that the canopy [[() 10 []]] is spanned

over lower arms [[()]] 32 [[()]] . The canopy [[()]] 10 [[()]] has creases along the lower arms [[()]] 32 [[()]] .

FIG. 9 shows in two isometric views two further wavy shaped embodiments of the umbrella or its canopy [[()]] 10 [[()]] . It is clear that the canopy [[()]] 10 [[()]] is tensioned over 5 oppositely angled edge rods [[()]] 15 [[()]] . The edge rods [[()]] 15 [[()]] can be straight or arcuate. The arms [[()]] 30 [[()]] do not directly tension the canopy [[()]] 10 [[()]] .

FIG. 10 shows in two isometric views a wavy embodiment of 10 the umbrella or its canopy [[()]] 10 [[()]] . It is clear that the canopy [[()]] 10 [[()]] is spanned over a circularly closed, elastic, and upwardly and downwardly shaped edge bow [[()]] 16 [[()]] and has no corners. The arms [[()]] 30 [[()]] do not directly tension the canopy [[()]] 10 [[()]] .

FIG. 11 shows in two isometric views embodiments of an 15 umbrella or its canopy [[()]] 10 [[()]] subdivided into sections. It is clear that the canopy [[()]] 10 [[()]] in one embodiment is shaped like a windmill. Open and closed sections alternate. In the other embodiments there are several adjacent open sections. The remainder of the canopy [[()]] 10 [[()]] is spanned over cables [[()]] 20 14 [[()]] at the edge of the open sections.

FIG. 12 shows in an isometric view an embodiment of the 25 umbrella or its center [[()]] 13 [[()]] . It is clear that the canopy center [[()]] 13 [[()]] is fixed on the axis [[()]] 1 [[()]] so as to influence its shape. In the illustrated case the canopy is drawn upward along the umbrella axis [[()]] 1 [[()]] .

5 FIG. 13 shows in isometric view an embodiment of the umbrella or its canopy center [[() 13 [()]]] . It is clear that the canopy center [[() 13 [()]]] is secured at the umbrella axis [[() 1 [()]]] , but the shape of the canopy [[() 10 [()]]] is not influenced. The canopy center [[() 13 [()]]] lies at the natural rest point of the canopy [[() 10 [()]]] .

10 FIG. 14 shows in isometric view an embodiment of the umbrella or its canopy [[() 10 [()]]] . It is clear that the canopy is cut out at the canopy center [[() 13 [()]]] and spacedly surrounds the umbrella axis [[() 1 [()]]] . The canopy center [[() 13 [()]]] lies at the natural rest point of the canopy [[() 10 [()]]] .

15 FIG. 15 shows in isometric view an embodiment of the umbrella or its canopy [[() 10 [()]]] . It is clear that the canopy is not necessarily cut out at the canopy center [[() 13 [()]]] since the shaft [[() 20 [()]]] ends above the canopy [[() 10 [()]]] and is held from above. The canopy center [[() 13 [()]]] lies at the natural rest point of the canopy [[() 10 [()]]] .

20 FIG. 16 shows in two isometric views embodiments of the umbrella or its canopy [[() 10 [()]]] . It is clear that the canopy [[() 10 [()]]] has fold lines extending straight between the canopy corners [[() 12 [()]]] and the canopy center [[() 13 [()]]] . This is ensured by highly prestressed sewn-in straps or cables.

25 FIG. 17 shows in two isometric views embodiments of the umbrella or its canopy [[() 10 [()]]] . It is clear that the canopy [[() 10 [()]]] has fold lines extending in arcs between the

canopy corners [[() 12 []]] and the canopy center [[() 13 []]] . This is ensured by lightly tensioned sewn-in straps or cables.

FIG. 18 shows in two isometric views an embodiment of the umbrella or its canopy [[() 10 []]] . It is clear that the canopy [[() 10 []]] is deformed into a wavy shape has no folds extend straight between the canopy corners [[() 12 []]] and the canopy center [[() 13 []]] . There are neither straps nor cables sewn into the canopy.

FIG. 19 shows a top view of an embodiment of the umbrella or its canopy [[() 10 []]] . The canopy edge [[() 11 []]] joining two corners [[() 12 []]] is shaped.

FIG. 20 shows in isometric view an embodiment of the umbrella or its arms [[() 30 []]] . It is clear that upper arms [[() 31 []]] and lower arms [[() 32 []]] meet the umbrella axis [[() 1 []]] at different levels. The upper arms [[() 30 []]] extend steeply above the canopy [[() 10 []]] and reach the low points [[() 35 []]] without touching the canopy [[() 10 []]] .

FIG. 21 shows in two isometric views an embodiment of the umbrella or its arms [[() 30 []]] . It is clear that in the first isometric view many but not all of the arms, in this example the upper arms [[() 31 []]] , are held up by cables. In the second isometric view all the arms of the umbrella, in the illustrated example the lower arms [[() 32 []]] are held up by cables.

FIG. 22 shows in two isometric views an embodiment of the umbrella or its arms [[() 30 []]] . It is clear that in the first isometric view many but not all of the arms, in this example

the upper arms [[()]] 31 [[()]] are held up by diagonal spreaders. In the second isometric view all the arms of the umbrella, in the illustrated example the lower arms [[()]] 32 [[()]] are held up by diagonal spreaders.

5 FIG. 23 shows in an isometric view an embodiment of the umbrella or its arms [[()]] 30 [[()]]. It is clear that all the lower arms are held up by the static properties of the canopy [[()]] 10 [[()]]. The canopy [[()]] 10 [[()]] itself is held up in this example by cables.

10 FIG. 24 shows in an isometric view an embodiment of the umbrella or its arms [[()]] 30 [[()]]. It is clear that many lower arms [[()]] 32 [[()]] are tensioned downward by cables.

15 FIG. 25 shows in an isometric view an embodiment of the umbrella or its arms [[()]] 30 [[()]]. It is clear that most of the arms [[()]] 30 [[()]] are pushed downward by diagonal spreaders.

FIG. 26 shows in an isometric view an embodiment of the umbrella or its arms [[()]] 30 [[()]]. It is clear that most of the arms [[()]] 30 [[()]] are tensioned downward by the static properties of the canopy [[()]] 10 [[()]].

20 FIG. 27 shows isometrically two embodiments of the umbrella or its opening and closing mechanism in different positions. In the first three views it is clear that downward movement of a runner sleeve [[()]] 25 [[()]] on which all of the arms [[()]] 30 [[()]] are pivoted opens the umbrella. In the next three views the umbrella is opened by downward movement of the shaft tip [[()]] 21 [[()]] on which all the arms [[()]] 30 [[()]] of the umbrella

are pivoted. Here the lengths of the diagonal spreaders [[()]] 43 [[()]] do not change.

FIG. 28 shows isometrically two embodiments of the umbrella or its opening and closing mechanism in different positions. In the first three views it is clear that downward movement of a sleeve [[()]] 25 [[()]] on which all of the arms [[()]] 30 [[()]] are pivoted opens the umbrella. The lengths of the cables between the shaft [[()]] 20 [[()]] and the high points [[()]] 34 [[()]] are constant. In the following three views the umbrella is opened by downward movement of the shaft tip [[()]] 21 [[()]] on which all of the upper arms of the umbrella are pivoted. Here the lengths of the diagonal spreaders [[()]] 43 [[()]] do not change. It is clearly visible that in both embodiments the lower arms [[()]] 32 [[()]] are drawn upwardly by the static properties of the canopy [[()]] 10 [[()]] .

FIG. 29 shows isometrically two embodiments of the umbrella or its opening and closing mechanism in different positions. In all views it is clear that the umbrella is opened by upward movement of the shaft tip [[()]] 21 [[()]] to which all the arms [[()]] 30 [[()]] are connected via diagonal spreaders [[()]] 43 [[()]] or cables [[()]] 40 [[()]] . The lengths of the diagonal spreaders [[()]] 43 [[()]] or the cables [[()]] 40 [[()]] between the shaft [[()]] 20 [[()]] and the arms [[()]] 30 [[()]] is constant.

FIG. 30 shows isometrically an embodiment of the umbrella or its opening and closing mechanism in different positions. In the views it is clear that the umbrella is opened by upward movement of a sleeve [[()]] 25 [[()]] to which all of the upper arms

[[()]] 31 [[()]] are connected via diagonal spreaders [[()]] 43 [[()]] . The lengths of the diagonal spreaders [[()]] 43 [[()]] between the shaft [[()]] 20 [[()]] and the arms [[()]] 30 [[()]] is constant. It is clearly visible that the lower arms are drawn upward by the static properties of the canopy [[()]] 10 [[()]] .

FIG. 31 shows isometrically an embodiment of the umbrella or its opening and closing mechanism in different positions. In the views it is clear that the umbrella is opened by drawing in cables [[()]] 40 [[()]] secured to the arms [[()]] 30 [[()]] of the umbrella.

FIG. 32 shows isometrically an embodiment of the umbrella or its opening and closing mechanism in different positions. In the views it is clear that the umbrella is opened by upward movement of a sleeve [[()]] 25 [[()]] to which all of the upper arms [[()]] 31 [[()]] are connected. It is also clearly visible that the lower arms [[()]] 32 [[()]] are drawn upward by the static properties of the canopy [[()]] 10 [[()]] .

FIG. 33 shows isometrically and in section an embodiment of the umbrella or its opening and closing mechanism. It is clearly visible that the sum of the length  $a_1$  of each of the upper arms [[()]] 31 [[()]] from the shaft [[()]] 20 [[()]] to the connection with the diagonal spreaders [[()]] 43 [[()]] and the length  $d_1$  of the respective diagonal spreaders [[()]] 43 [[()]] is equal to the length  $a_2$  of each of the lower arms [[()]] 32 [[()]] from the shaft [[()]] 20 [[()]] to the connection with the diagonal spreaders [[()]] 43 [[()]] and the length  $d_2$  of the respective diagonal spreader [[()]] 43 [[()]] .

5 FIG. 34 shows in section an embodiment of the umbrella or its opening and closing mechanism. It is clear that the arms [[()]] 30 [[()]] and the canopy [[()]] 10 [[()]] are secured at the canopy center [[()]] 13 [[()]] to a common runner sleeve [[()]] 25 [[()]]. During opening and closing of the umbrella they synchronously move along the umbrella axis [[()]] 1 [[()]].

10 FIG. 35 shows in isometric view an embodiment of the umbrella or an umbrella group. It is clear that several umbrellas can be joined together in a loosely connected row. In the illustrated embodiment the umbrellas used have high points [[()]] 34 [[()]] at adjacent edges so that rain water falling on them are moved outward to the high points [[()]] 35 [[()]].

15 FIG. 36 shows in isometric view an embodiment of the umbrella or an umbrella group. It is clear that at least four umbrellas are joined together loosely into a quadrilateral. In the illustrated embodiment umbrellas are used that have two upper arms [[()]] 31 [[()]] and two lower arms [[()]] 32 [[()]]. The umbrellas are each oriented with a upper arm [[()]] 31 [[()]] in the center so that dropping rain is largely deflected outward to the low points [[()]] 35 [[()]].

20 FIG. 37 shows in isometric view an embodiment of the umbrella or an umbrella group. It is clear that lamps [[()]] 6 [[()]] that illuminate the canopy [[()]] 10 [[()]] can be mounted on the shaft [[()]] 20 [[()]] or the support [[()]] 50 [[()]].

25 In the following FIGS. 38 to 48 the umbrella is further described with respect to selected embodiments.

FIG. 38 shows in top view embodiments of the umbrella or its canopy [[() 10 ()]]. It is clear that the canopy corners [[() 12 ()]] define very different shapes seen from above.

5 FIG. 39 shows in two isometric views the umbrella or its arms [[() 30 ()]]. It is clear that the arms [[() 30 ()]] can be made arcuate.

10 FIG. 40 shows in isometric view an umbrella with a wavy canopy [[() 10 ()]] and alternating high points [[() 34 ()]] and low points [[() 35 ()]] where the canopy in top view is of quadratic shape. All the upper arms [[() 31 ()]] and lower arms [[() 32 ()]] are pivotally supported on a runner sleeve [[() 25 ()]] shiftable along the shaft [[() 20 ()]]. Even the canopy [[() 10 ()]] is secured at the canopy center [[() 13 ()]] with the lower end of this sleeve [[() 25 ()]]. The upper arms [[() 31 ()]] are held up by cables [[() 4 ()]] that join outer ends [[() 33 ()]] of the upper arms [[() 31 ()]] with a projecting mount [[() 28 ()]] carried on the shaft tip [[() 21 ()]]. The lower arms [[() 32 ()]] for their part are drawn upward by the canopy edge [[() 11 ()]] that joins high points [[() 34 ()]] and low points [[() 35 ()]]. As a result of the elasticity of the canopy [[() 10 ()]] along the connecting line between the umbrella axis [[() 1 ()]] and the low points [[() 35 ()]] there is force balancing that stabilizes the umbrella. In this case 15 sewn-on belts, integrated cables, or the like give the canopy [[() 10 ()]] static properties and as a result of the oppositely arched shape it is particular wind resistant and stable as regards shape. The shaft [[() 20 ()]] is in this illustrated example formed as a 20 25

5 mast. When the umbrella is closed the runner sleeve [[()]] 25 [[()]] is shifted upward on the shaft [[()]] 20 [[()]] . This pivots the upper arms [[()]] 31 [[()]] and the lower arms [[()]] 32 [[()]] downward. The sleeve [[()]] 25 [[()]] is moved upward on the shaft for closing until the cables [[()]] 40 [[()]] connected to the mount [[()]] 20 [[()]] extend vertically and thus parallel to the umbrella axis [[()]] 1 [[()]] and form between the axes of the upper arms [[()]] 31 [[()]] and the cables [[()]] 40 [[()]] at a positive starting angle that facilitates opening of the umbrella or at least makes it possible. When opening, the sleeve [[()]] 25 [[()]] is moved 10 downward so that the upper arm [[()]] 31 [[()]] pivot upward with their upper points [[()]] 34 [[()]] and the lower arms [[()]] 32 [[()]] are drawn upward by the canopy edge [[()]] 11 [[()]] and or the edge cables [[()]] 24 [[()]] until the pull between the umbrella axis [[()]] 1 [[()]] and the low points [[()]] 35 [[()]] starts. It is 15 particular notable that closing of the umbrella functions also on raising of the sleeve [[()]] 25 [[()]] even with a table underneath it because the sleeve [[()]] 25 [[()]] also moves the arms [[()]] 30 [[()]] upward. On opening it is again moved downward and ensures as 20 a result of the small spacing from the ground good sun protection. In addition it should be noted that, on closing, the sleeve [[()]] 25 [[()]] also draws the canopy [[()]] 10 [[()]] at its center [[()]] 13 [[()]] upward so that the umbrella in closed condition has no little folds.

25 FIG. 41 shows in isometric view an umbrella with an alternately upward and downwardly folded canopy [[()]] 10 [[()]] .

It is clear that the lower arms [[()]] 32 [[()]] are tensioned downward by cables [[()]] 40 [[()]] to the shaft [[()]] 20 [[()]].

5 FIG. 42 shows a section through an embodiment of the umbrella or its shaft [[()]] 20 [[()]]. It is clear that inside the shaft [[()]] 20 [[()]] there is a threaded spindle [[()]] 22 [[()]] carrying a nut [[()]] 29 [[()]]. Pins extending through vertical slits in the shaft [[()]] 20 [[()]] connect the nut [[()]] 29 [[()]] with the sleeve [[()]] 25 [[()]] that can be moved to open the umbrella.

10 FIG. 43 shows a section through an embodiment of the umbrella or its arm [[()]] 30 [[()]]. It is clear that the arm [[()]] 30 [[()]] is formed with a groove in which the canopy [[()]] 10 [[()]] is guided.

## Reference list

1	umbrella axis
10	canopy
11	canopy edge
5	canopy corner
12	canopy center
13	canopy edge cable
14	canopy edge bar
15	canopy edge curve
10	canopy intermediate part
17	shaft
20	shaft tip
21	threaded spindle
22	crank
15	bevel-gear drive
24	sleeve
25	mount
28	nut
29	arm
30	upper arm
20	lower arm
31	outer end
32	high point
33	low point
25	cable
40	diagonal spreader

46           tensioning element  
50           support  
51           anchor  
52           hanger  
5            60           lamp

For the sake of completeness, all the references used in the drawing are described:

The umbrella axis [[() 1 ()]] is the imaginary geometric axis of the umbrella or its shaft [[() 20 ()]] . Most 10 embodiments are rotation symmetrical to this axis [[() 1 ()]] .

The canopy [[() 10 ()]] is the flexible surface that is tensioned directly or indirectly by the arms [[() 30 ()]] . It is made for example of a foil, a textile or another membrane and serves for example for protection from sun and/or rain and/or as a 15 reflection surface.

The canopy edge [[() 11 ()]] delimits the canopy [[() 10 ()]] at its outer periphery. The canopy edge [[() 11 ()]] can be reinforced by standard static procedures.

The canopy corners [[() 12 ()]] are points at which the canopy edge [[() 11 ()]] is drawn outward by the arms [[() 30 ()]] of the umbrella. 20

The canopy center [[() 13 ()]] is the imaginary geometric intersection of the umbrella axis [[() 1 ()]] with the canopy [[() 10 ()]] .

The canopy-edge cable [[() 14 ()]] is a tensioned cable 25 that lies outside the canopy [[() 10 ()]] , extending between

adjacent outer ends [[()]] 33 [[()]] of the arms [[()]] 30 [[()]] of the umbrella and uniting the canopy edge [[()]] 11 [[()]] statically.

The canopy-edge rods [[()]] 15 [[()]] are rods connected together as links or a closed chain that are joined at their ends, the joints, at arms [[()]] 30 [[()]] and that tension the canopy.

The canopy-edge bow [[()]] 16 [[()]] is an advantageously elastic annularly closed rod that is fixed at points to the arms [[()]] 30 [[()]] and that tensions the canopy [[()]] 10 [[()]].

The canopy intermediate parts [[()]] 17 [[()]] are small canopies [[()]] 10 [[()]] that are used to close gaps between adjacent umbrellas.

The shaft [[()]] 20 [[()]] is that portion of the mast on which the static elements necessary for opening the umbrella are mounted directly or indirectly and can be fixed or movable.

Those parts of the mast do not constitute the shaft that carry the shaft [[()]] 20 [[()]]. They are referred to as a support [[()]] 50 [[()]], anchor [[()]] 51 [[()]], or hanger [[()]] 52 [[()]]. The shaft [[()]] 30 [[()]] and anchor [[()]] 51 [[()]] can be made of a continuous round tube, that together form the "mast."

The shaft tip [[()]] 21 [[()]] is the upper or lower free end of the shaft [[()]] 20 [[()]]. The shaft tip [[()]] 21 [[()]] can, if necessary for the opening and closing mechanism, telescope on the shaft [[()]] 20 [[()]].

The threaded spindle [[()]] 22 [[()]] is a threaded rod that is inside the shaft [[()]] 20 [[()]], and preferably operated through a bevel-gear drive [[()]] 24 [[()]] by a crank [[()]] 23 [[()]].

and moving the parts, as for example the shaft tip [[()]] 21 [[()]] or the sleeve [[()]] 25 [[()]] for opening and closing the umbrella.

The bevel-gear drive [[()]] 24 [[()]] is actuated by a crank [[()]] 23 [[()]] and when turned moves the threaded spindle [[()]] 22 [[()]] for shifting the parts necessary for opening and closing the umbrella. The bevel-gear drive [[()]] 24 [[()]] is preferably mounted inside the shaft [[()]] 20 [[()]].

The runner sleeve [[()]] 25 [[()]] is a movable mechanical part on the shaft [[()]] 20 [[()]] to which the arms [[()]] 30 [[()]], cables [[()]] 40 [[()]] or diagonal spreaders [[()]] 43 [[()]] are connected. Moving the sleeve [[()]] 25 [[()]] opens and closes the umbrella. The sleeve [[()]] 25 [[()]] can, unlike in normal parlance, be a part movable along the umbrella axis [[()]] 1 [[()]] to which the diagonal spreaders [[()]] 43 [[()]] are connected and that does not require have a hole at the umbrella axis [[()]] 1 [[()]] since it does not surround a shaft [[()]] 20 [[()]] ending above and is only connected with it via a tension cable.

The mount [[()]] 28 [[()]] is a spacer mounted directly or indirectly fixedly or movably on the shaft [[()]] 20 [[()]] to which the arms [[()]] 30 [[()]], the cables [[()]] 40 [[()]], or the diagonal spreaders [[()]] 43 [[()]] are connected so that when the umbrella is closed there is a small acute angle between the arms [[()]] 30 [[()]] and the cables [[()]] 40 [[()]] or the diagonal struts [[()]] 43 [[()]] so as to facilitate opening of the umbrella.

The threaded nut [[()]] 29 [[()]] is the mechanical part inside the shaft [[()]] 20 [[()]] that is shifted upward and downward along the axis [[()]] 1 [[()]] by the threaded spindle [[()]] 22 [[()]].

. The nut [[()]] 29 [[()]] for example moves the sleeve [[()]] 25 [[()]] or the shaft tip [[()]] 21 [[()]] .

The arms [[()]] 30 [[()]] are [[the]] pivotally mounted rods extending radially from the axis [[()]] 1 [[()]] and directly or 5 indirectly tensioning the canopy [[()]] 10 [[()]] . The arms [[()]] 30 [[()]] are held in position by the cables [[()]] 40 [[()]] , diagonal spreaders [[()]] 43 [[()]] , and/or the tension of the canopy [[()]] 10 [[()]] in their position tensioning the canopy [[()]] 10 [[()]] . According to the embodiment, the arms [[()]] 30 [[()]] are bent when tensioned or if necessary are made arcuate.

10 The upper arms [[()]] 31 [[()]] are those arms [[()]] 30 [[()]] that draw the canopy [[()]] 10 [[()]] upward directly or indirectly. According to embodiment, the upper arms [[()]] 31 [[()]] are differently inclined from the umbrella axis [[()]] 1 [[()]] .

15 The lower arms [[()]] 32 [[()]] are those arms [[()]] 30 [[()]] that draw the canopy [[()]] 10 [[()]] downward directly or indirectly. The lower arms are always differently inclined downward from the axis [[()]] 1 [[()]] .

The outer ends [[()]] 33 [[()]] are the actual outer ends 20 turned away from the axis [[()]] 1 [[()]] of the arms [[()]] 30 [[()]] . The outer ends [[()]] 33 [[()]] are usually connected to the canopy corners [[()]] 12 [[()]] .

25 The high points [[()]] 34 [[()]] are the outer actual ends turned away from the axis [[()]] 1 [[()]] of the upper arms [[()]] 31 [[()]] . They also refer to the outer joints between adjacent canopy edge rods [[()]] 15 [[()]] .

The low points [[()]] 35 [[()]] are the outer actual ends turned away from the axis [[()]] 1 [[()]] of the lower arms [[()]] 32 [[()]] . They also refer to the outer joints between adjacent canopy edge rods [[()]] 15 [[()]] .

5 The cables [[()]] 40 [[()]] are tensioned cables that join the outer ends [[()]] 33 [[()]] with the shaft [[()]] 20 [[()]] or the mount [[()]] 28 [[()]] .

10 The diagonal spreaders [[()]] 43 [[()]] are push-type rods and/or tension cables that connect points along the arms [[()]] 30 [[()]] with the shaft [[()]] 20 [[()]] or with the mount [[()]] 28 [[()]] .

15 The tensioning elements [[()]] 46 [[()]] are fittings that engage between the canopy corners [[()]] 12 [[()]] and the outer ends [[()]] 33 [[()]] of the arms [[()]] 30 [[()]] . The tensioning elements are in particular used in umbrella groups in order to install a canopy [[()]] 10 [[()]] after the arms [[()]] 30 [[()]] have been unfolded to form a throughgoing canopy [[()]] 10 [[()]] .

20 The support [[()]] 50 [[()]] is the static part [[s]] that holds the shaft [[()]] 20 [[()]] , that is that connects the lower end of the shaft [[()]] 20 [[()]] to the floor or that engages the shaft [[()]] 20 [[()]] from above and allows the umbrella to be mounted on a wall or structure extending up from the floor.

25 The anchor [[()]] 51 [[()]] is a static part that holds the shaft [[()]] 20 [[()]] and connects it to the floor. The simplest embodiment of an anchor [[()]] 51 [[()]] is a mast.

The hanger [[()]] 52 [[()]] is a part that engages over the shaft from above.

The lamp [[()]] 60 [[()]] is an emitter or projector that illuminates the canopy [[()]] 10 [[()]] . The lamp [[()]] 60 [[()]] can illuminate or project advertising on the umbrella.